Project Title: **Investigating ribosome hibernation in archaea from cells to atoms**

Main Supervisor: **Bertram Daum** Co- Supervisor: **Stefano Pagliara**

Project

Ribosomes are the molecular protein factories within all living cells and their regulation is central to cellular survival under stress. Many organisms conserve energy during nutrient limitation or dormancy by inactivating ribosomes through "hibernation." While ribosome hibernation has been studied extensively in bacteria and eukaryotes, it remains poorly understood in archaea; microorganisms that thrive in some of the most extreme environments on Earth. This project will explore the mechanisms of archaeal ribosome hibernation across multiple scales, from whole-cell organisation to atomic-resolution structures.

The PhD student will use an integrative, scale-spanning approach. Live-cell microscopy combined with microfluidic platforms will allow precise control of growth conditions and real-time monitoring of ribosome behaviour during stress and recovery. Omics approaches, including transcriptomics and proteomics, will provide complementary insights into how gene expression and protein composition are remodelled during hibernation. Cryo-electron tomography (cryoET) will reveal the spatial organisation of ribosomes in intact cells, while single-particle cryoEM will resolve structural transitions and identify hibernation factors that remodel or dimerise ribosomes. Comparative analyses across archaeal species will highlight conserved and divergent regulatory strategies.

By mapping ribosome hibernation "from cells to atoms," this project will provide fundamental insights into how archaea regulate translation and survive harsh conditions. Beyond archaeal biology, the work has broad implications for understanding the evolution of ribosome control, microbial dormancy, and the persistence of pathogens. The student will gain cutting-edge expertise in structural biology, live-cell imaging, microfluidics, and omics, preparing them for interdisciplinary research at the frontier of molecular and cellular biology.